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## (54) Airport runway lighting cleaning system

(57) An airport runway lighting system is cleaned using an anthropomorphic telemanipulator, vehicular mounted, whose ground movements in tracing and circumnavigating the runway light patterns are controlled by an automatic guidance system. Cleaning may be effected ultrasonically. The specification also envisages such guidance systems being used for other aircraft servicing vehicles, e.g. baggage trucks and mobile passenger lounges.

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## SPECIFICATION

### Improvements in and relating to a method of cleaning aerodrome runway lighting systems

This invention relates to the cleaning of aerodrome runway lighting systems.

- Runway lighting brilliance is affected by dirt deposited on the outer lens, lenses are normally washed manually. This is a costly time consuming method which is normally carried out daily as routine maintenance.

- The lens cleaning method of this invention is intended to take place daily or as often as is deemed necessary, thus preventing an accumulation of dirt particles being deposited upon the outer skin of the lamp housing and lens.

- According to this invention the cleaning is carried out by anthropomorphic telemanipulators or robot mounted on a suitable mobile vehicle capable of reaching the further most points of both runway and approach lighting system. Using brushes or liquid pressure jet systems or combinations thereof or ultrasonic devices to effect the cleaning cycle.

- According to a further provision of this invention the mobile vehicle upon which the telemanipulator or robot is mounted is directed to and from the runway to be cleaned upon receiving transmitted control information impulses via the electric conductor either set in or affixed to the runway surface. This conductor takes the form of the plan view of the runway lighting layout. Information for each runway layout is transmitted on a different frequency via its own conductor thereby ensuring that the cleaning vehicle does not make physical contact with other structures in its path, thus avoiding possible damage to that structure or vehicle.

According to a further embodiment of this invention the electrical conductor method be replaced by a fibre optic system.

- According to a still further embodiment on board minicomputer and microprocessors using the basis of sensory information gathered by triangulation of vehicle position in relating to runway lighting configuration, steer the cleaning vehicle around the lighting system layout.

- According to a further provision of this invention vehicle guidance is performed using automated scene analysis via processed visual information for determining the relative position of runway obstacles to the cleaning vehicle.

- According to a still further embodiment of this invention there is provided a vehicle guidance system based on terrain comparison. This technique depends upon the comparison of one or more sensor measurement histories with expected measurement histories generated by modelling the trijectory and environment.

According to a further embodiment of this invention microwave, infrared doppler radar or radio link systems can be adapted for vehicular guidance.

- A still further embodiment of this invention there is provided for one of the aforementioned guidance systems to be used in conjunction with other types of vehicles used in the servicing of aircraft requirements whilst grounded by way of loading and unloading cargo, baggage mobile passenger lounges commissary trucks and the like.

- A further embodiment of this invention there is provided a method for applying de-icing fluids to runway lamp housings and lenses, either in suspension with the cleaning fluids, or separately after cleaning.

- A still further embodiment of this invention there is provided a means of checking the light intensity and luminosity of each individual lamp to be cleaned, and via computer control report reduction in luminosity and lamp failures to Air Traffic Control (A.T.C.) for remedial action. Thus ensuring category lighting standards are maintained.

- According to a still further embodiment of this invention the light being emitted by the runway lighting be detected processed and used as a means of directing navigating and guiding the cleaning vehicle.

- There now follows a description of a particular embodiment of the invention by way of example only.

- A suitable sized vehicle upon which a telemanipulator is mounted, fitted to which is a ultrasonic cleaning system. The vehicle is self contained with sufficient liquid to carry out the lamp cleaning operation, and power to carry out all the vehicular driving steering control functions as well as powering the manipulator and washing system.

- As and when required the runway light cleaning vehicle proceeds along the allotted runway, either driver operated, or without driver, the steering functions being controlled by one of the aforementioned guidance systems. Moving from lamp to lamp carrying out the lens and lamp housing cleaning sequence with the robot or telemanipulator handling the ultrasonic head as directed. At the same time checking on the brilliance of each lamp and reporting upon its luminosity. After cleaning the runway lighting system the taxi track or approach lights can be cleaned as directed before the vehicle returns to the park position at base to await further instructions.

## CLAIMS

1. An airport runway lamp cleaning system using vehicular mounted anthropomorphic telemanipulator or robot actuated cleaning methods steered and manoeuvred around runway lighting by a sunken or surface fixed electric inductance wire guidance system.

2. A runway lamp cleaning system claimed

in 1 above in which the vehicle guidance method is fibre optics.

3. A cleaning system as claimed in 1 & 2 above in which vehicle control is achieved by a minicomputer sensory information guidance system.

4. A runway lamp cleaning system as claimed in 1, 2 & 3 above in which automated scene analysis based on visual information guides the vehicle around the Airports runway lighting system.

5. A lamp cleaning system as claimed in 1, 2, 3, & 4 above in which vehicular guidance is achieved by a terrain comparison method.

6. A mobile cleaning system as described in 1, 2, 3, 4, & 5 above in which vehicular guidance is controlled by either microwave transmissions, infrared means, doppler radar methods, or radio controlled devices.

7. A runway approach light cleaning system as claimed in 1, 2, 3, 4, 5 & 6 above in which de-icing fluids can be applied to the lens surfaces either with or without the cleaning medium.

8. A mobile system as described in 1, 2, 3, 4, 5, & 6 above in which other aircraft servicing vehicles can be controlled by any of the methods described therein.

9. An Airport runway light cleaning system claimed in 1, 2, 3, 4, 5, 6, 7, & 8 above in which the vehicular guidance and cleaning can be fully automatic.

10. An Airport runway lamp cleaning system as claimed in 1, 2, 3, 4, 5, 6, 7, 8, & 9 above in which vehicular guidance is achieved by detecting and sensing the runway lamp illumination and guiding the vehicle correspondingly.

11. An Airport runway lamp cleaning system as claimed in 1, 2, 3, 4, 5, 6, 7, 8, 9, & 10 above in which each lamp after cleaning is measured automatically for luminosity, and deterioration in brightness being compared with historic minimum values and reporting via the computer link its findings. Thus ensuring that the minimum luminosity for a given runway category standard of illumination is maintained.

12. An Airport runway lamp cleaning system as claimed in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 & 11 above in which the cleaning head is a fabrication within which suitable ultrasonic transducers are mounted so that when the head is sealed against the runway and a cleaning fluid is introduced into the cavity the cleaning cycle commences.

13. An Airport runway lamp cleaning system as claimed in 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11 & 12 above in which a multiple ultrasonic cleaning head device is mounted to the end of a telemanipulator to enable pole mounted runway and approach lamps to be cleaned ultrasonically.

14. A fully or semi automatic vehicular mounted telemanipulator ultrasonic cleaning device for cleaning airport runway lighting systems manufactured by a method as claimed in

any of the preceding claims.

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